Name _____

Pd. _____ Date: _____

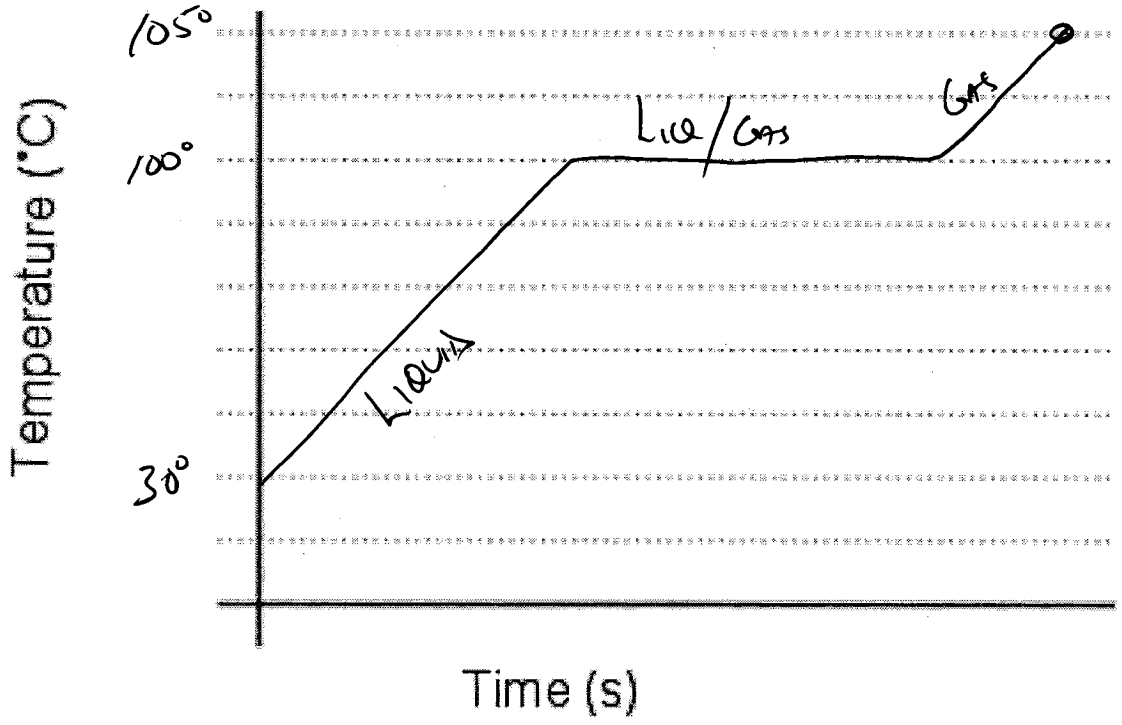
Competency	Grade
3.1 Specific Heat Calcs	
3.2 Energy Bar Chart	
3.3 Temperature Graphs	

Unit 3 Test

3.3 Temperature Graphs

Proficient Questions (75%)

1. A sample of liquid water at 30°C is heated to 105°C
   - For this situation sketch the temperature-time graph on the axes below.
   - Be sure to include beginning and ending temperatures as well as the temperature during any phase change.
   - Label which phase(s) is(are) present in each portion of the curve. (ex. Solid, liquid, gas)



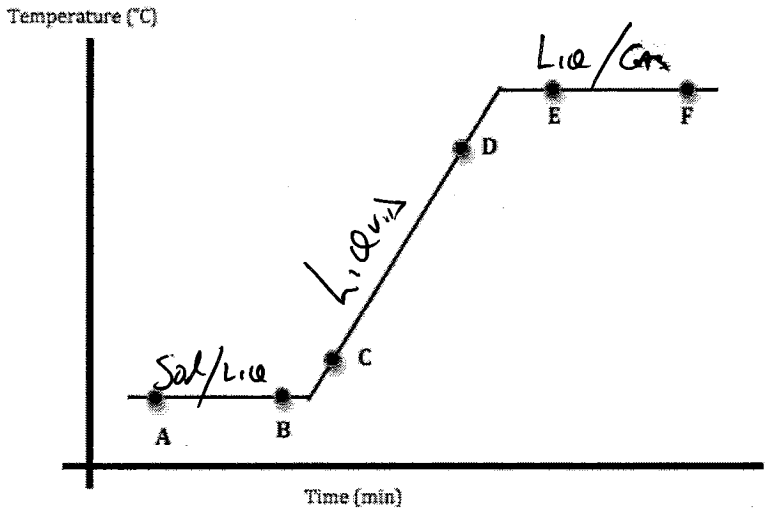
2. The temperature of a substance as it is steadily cooled is shown in the graph below. Show the changes in matter and energy by adding these to each graph:

Between each pair of labeled points

(A-B, C-D…), write or draw

a. the state(s) of matter that are present (ex: Solid, liquid, gas, etc.)

b. the change that is occurring (ex: temperature increasing, melting, condensing, etc.



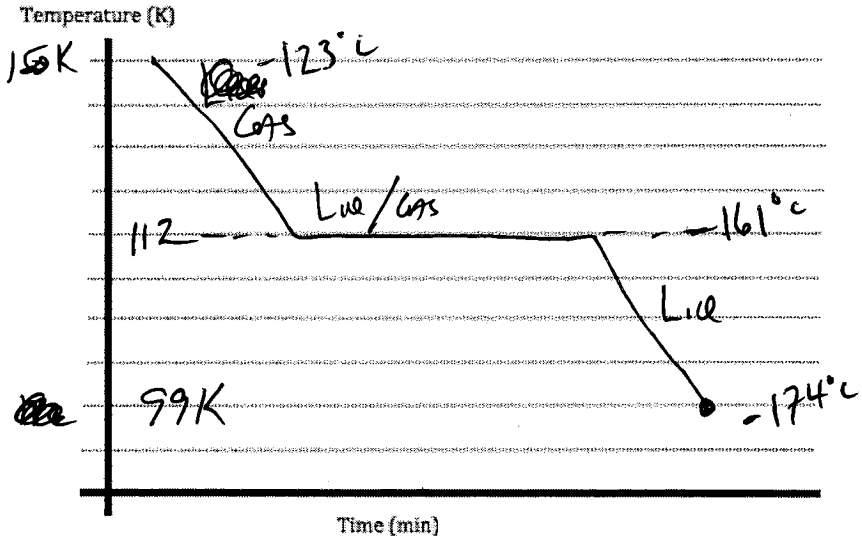
Interval	Description	
A - B	State(s) Present	Solid / Liquid
	Change	Melting
C - D	State(s) Present	Liquid
	Change	Temp ↑
E - F	State(s) Present	Liquid / Gas
	Change	Evaporation

Advanced Questions (100%)

123°C

3. Methane at 150 K is converted all the way to methane liquid at 99 K.
   a. Sketch the cooling curve for this process.
   b. Label all of the states present in each section of the curve.

   (Melting point of methane = 91 K; Boiling point of methane = 112 K)

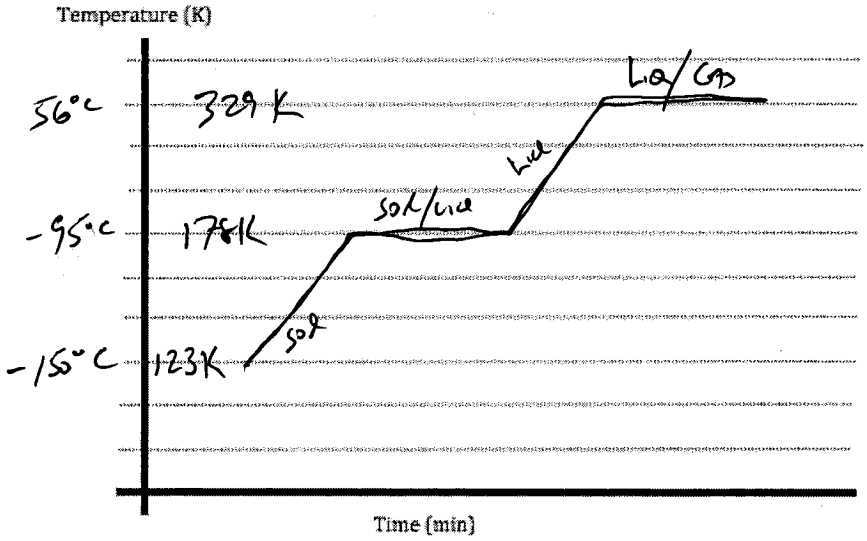


123K

4. Solid acetone at -150°C is heated until it forms a gas at its boiling point.
   a. Sketch the cooling curve for this process.
   b. Label all of the states present in each section of the curve.

   (Melting point of acetone = 178 K; Boiling point of acetone = 329 K)

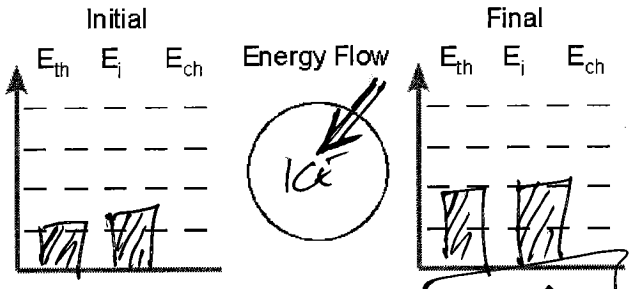
-95°C 56°C



3.2 Energy Bar Charts

Proficient Questions (75%)

1. An ice cube at -5°C melts in a cup of juice at 25°C. Draw the energy diagram for both the ice cube and the juice.

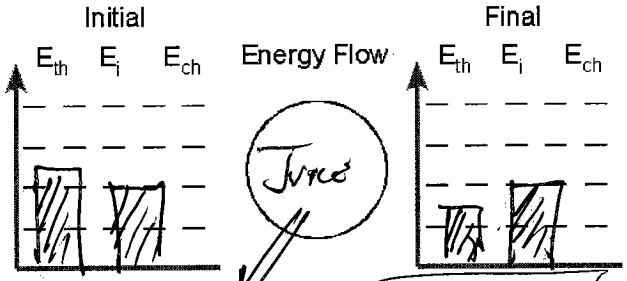


Ice cube

E_i ↑

Arrow in

E_{th} ↑



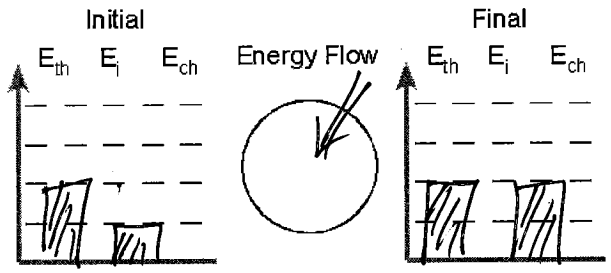
juice

E_{th} ↓

E_i =

Arrow out

2. Ice at 0°C melts to a liquid at 0°C. Draw the energy bar chart.

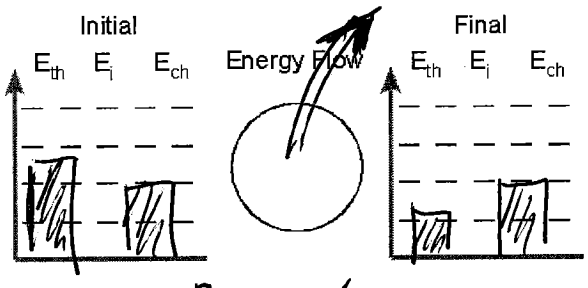


E_{th} =

E_i up

Arrow in

3. A pan of water (25°C) is cooled to freezing and some of the water begins to form ice. Do separate energy bar charts for each stage of the process. Below each graph label the process that is taking place.

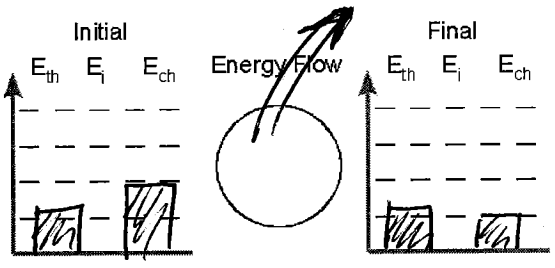


Process: Cooling

E_{th} ↓

E_i =

Arrow out



Process: Freezing

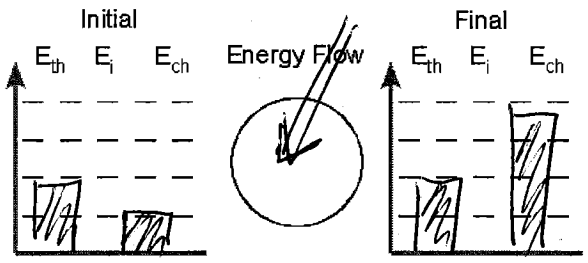
E_{th} =

E_i ↓

Arrow out

Advanced Questions (100%)

4. To transfer pictures onto fabric manufacturers heat solid ink directly to a gas in a process called sublimation. The ink vapor is then sprayed onto the fabric forming a thin, solid layer at a cooler temperature. Do separate energy bar charts for each stage of the process. Below each graph label the process that is taking place.

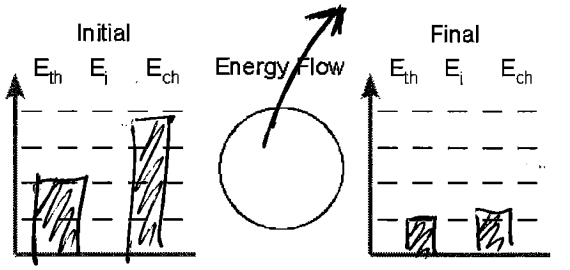


Process: SUBLIMATION

Arrow IN

E_{th} ?

E_i ↑



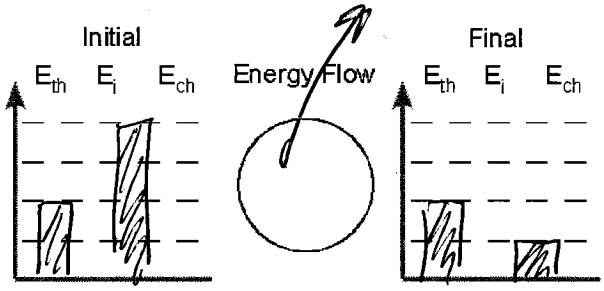
Process: Cooling

E_{th} ↓

E_i ↓

Arrow OUT

5. Carbon dioxide gas at 195 K can form solid carbon dioxide at the same temperature in a process called deposition.

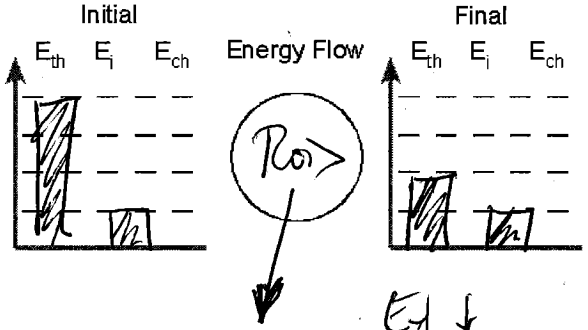


E_{th} =

E_i = ↓

Arrow = OUT

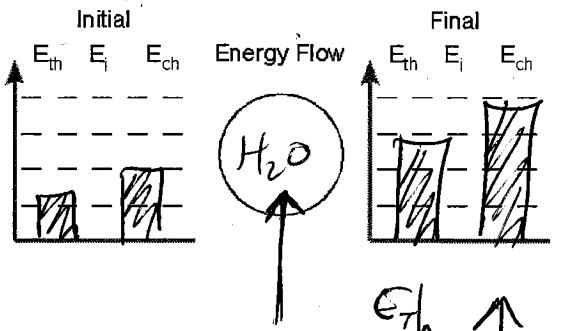
6. A student heats a metal rod up until it is glowing red. The student then dunks that hot metal rod into a container of water at room temperature. The water almost immediately starts to boil. Draw separate bar charts for the metal rod and the water during this process.



E_{th} ↓

E_i =

Arrow OUT



E_{th} ↑

E_i

Arrow IN

3.1 Specific Heat Calculations

Proficient Questions (75%)

Be sure to show work, round to the proper number of sig figs and label quantities.

Energy	**Constants (H_2O)**	
334 J/g	Heat of fusion (melting or freezing) H_f	**$E = m\,C\,(T_{end} - T_{begin})$**
2260 J/g	Heat of vaporization (evaporating or condensing) H_v	**$E = m\,H$**
2.0 J/g°C	Heat capacity (c) of water vapor	
4.18 J/g°C	Heat capacity (c) of liquid water	
2.1 J/g°C	Heat capacity (c) of solid water	

1. Water (250g) at 75°C is cooled to 15°C. How much energy did this release?

$(250)(4.18)(60) = 62700$

63 KJ

2. **Solid Ice** (175g) is heated from 0.0°C to 37°C. How much energy was required?

$(175)(334) = 58450$

$(175)(4.18)(37) = 27066$

85516

86 KJ

3. Water sits in a bottle in a freezer. A student takes readings and finds that there are 450 mL of water in the bottle, and that the current temperature is 95.0°C. The freezer is turned on and the freezer absorbs 245 kJ of energy from the water as it cools. How much of the original water is frozen solid during the process?

$(450)(4.18)(95) = 178695$

$245{,}000 - 178695 = 66305$

$66305 = 334\,m$

$m = 198.5$

199 g or 200 g

Advanced Questions (100%)

4. A student observes a cup and finds that it has 67g of ice and 33g of liquid water thoroughly mixed inside it. Four hours later the student returns to find the ice melted and the liquid inside the cup at a temperature of 27°C. How much energy did the water absorb from the surroundings during those four hours?

$(67)(334) = 22378$

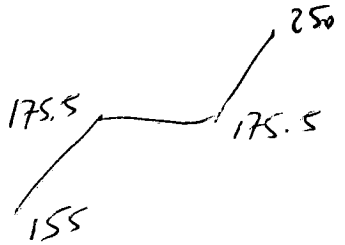
$(100)(4.18)(27) = 11286$

33664

34 KJ

5. A container of 125 g of methanol is heated from 155 K up to 250 K. How much heat is absorbed in the process?

Heats of Physical Change						
Substance	C_{sol} (J/g°C)	C_{Liq} (J/g°C)	Freezing point (K)	ΔH_{fus} (J/g)	Boiling point (K)	ΔH_{vap} (J/g)
Methanol	1.95	2.50	175.5	99	337.2	1103



$(125)(1.95)(175.5-155) = 4997$

$(125)(99) = 12375$

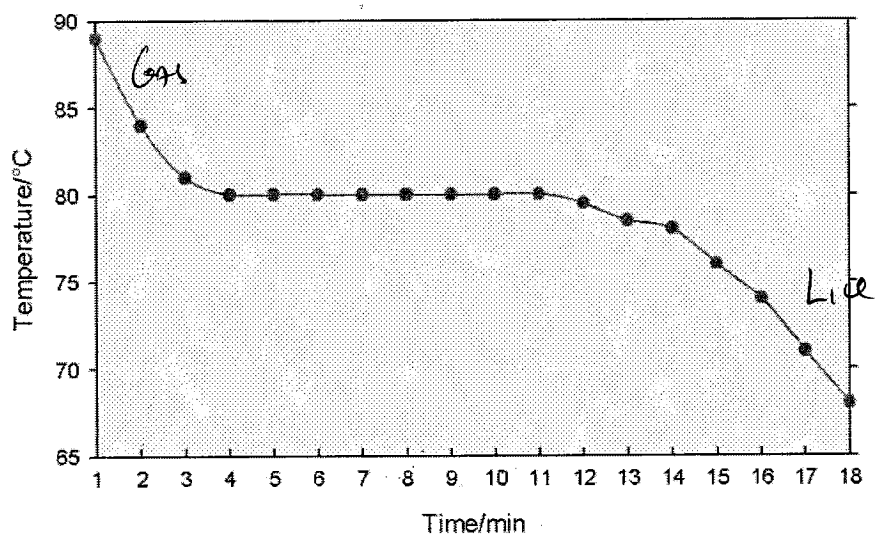
$(125)(2.5)(250-175.5) = 23281$

40653

41 KJ

6. The following graph shows 45 g of an unknown substance being cooled from a gas to a liquid. Calculate the total energy released by the substance during the time period shown on the graph.

2.52 J/g°C	Heat capacity (c) of solid unknown		327 J/g	Heat of Fusion (H_{fus})
2.73 J/g°C	Heat capacity (c) of liquid unknown		995 J/g	Heat of Vaporization (H_{vap})
2.05 J/g°C	Heat capacity (c) of gas unknown			



$(45)(2.05)(89-80) = 830$

$(45)(995)(= 44775$

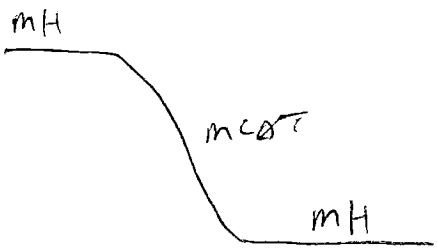
$(45)(2.73)(67-80) = 1597$

47202

47 KJ

ALTERNATE VERSION

#6



$(45)(995) = 44775$

$(45)(2.73)(80-12) = 8354$

$(45)(327) = 14715$

67844

$68\ KJ$